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THE BOTANICAL GAZETTE

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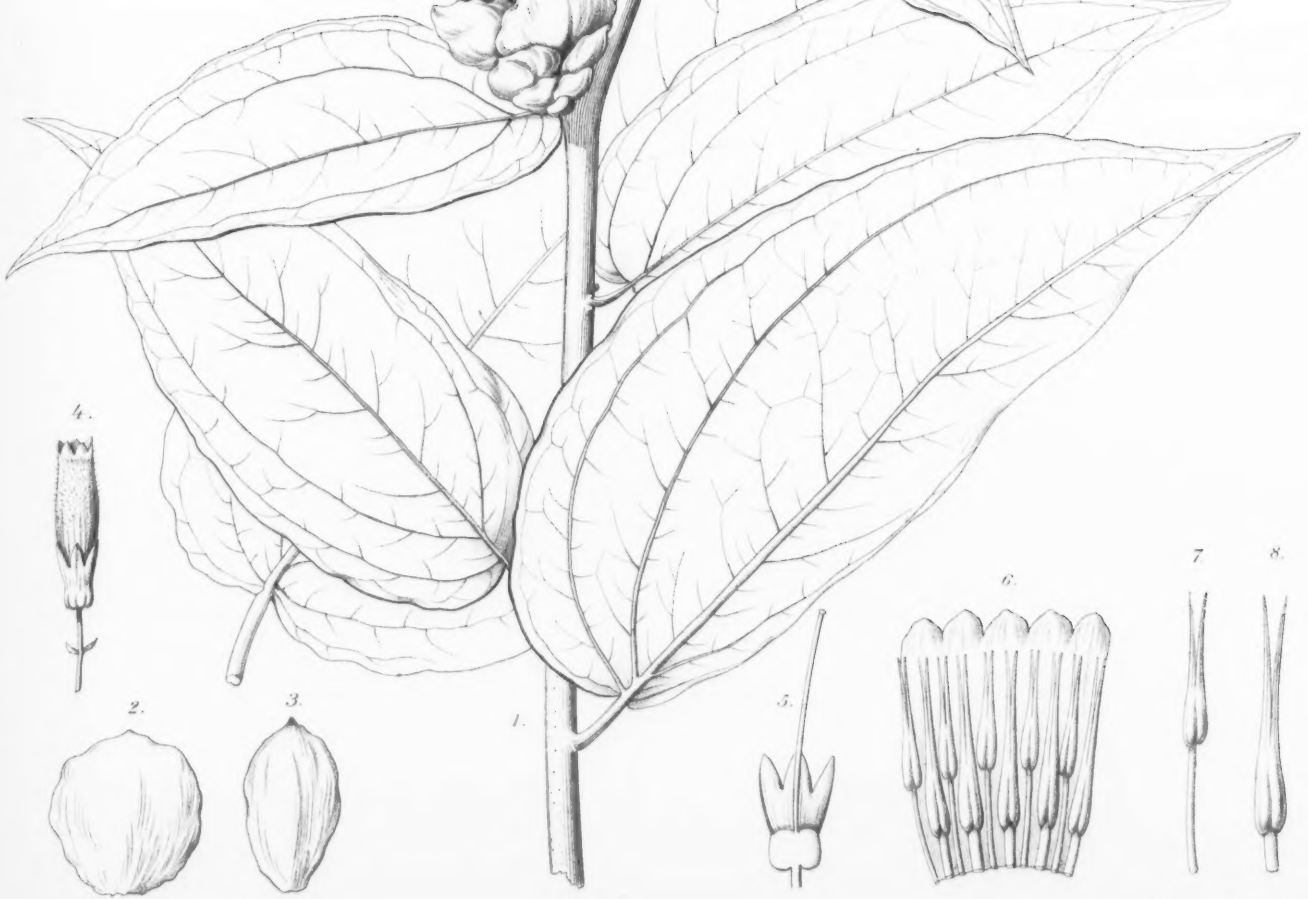
In the February number will appear:

New or noteworthy plants from Guatemala, by DR. JOHN M. COULTER, *Lake Forest University.*

A preliminary paper on Costaria, with description of a new species, by DEALTON SAUNDERS, *Lincoln, Nebraska.*

The flora of Mt. Mansfield, Vermont, by W. W. EGGLESTON, *Rutland, Vt.*

Noteworthy anatomical and physiological researches.



C E Faxon, del.

B. Mansel, lith. Boston

CAVENDISHIA CALLISTA. Donnell Smith.

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B. Meisel, Lith. Boston.

CAPPARIS HEYDEANA. Donnell Smith.

C.E. Faxon, del.

B. Meisel, Lith. Boston.

CHAUNOSTOMA MECISTANDRUM. Donnell Smith.

BOTANICAL GAZETTE

JANUARY, 1895.

Undescribed plants from Guatemala and other Central American Republics. XIV.

JOHN DONNELL SMITH.

WITH PLATES I–III.

Porcelia microcarpa Donnell Smith.—Pubens. Folia membranacea, adulta praeter margines nervosque glabrescentia, obovato-elliptica abrupte acuminata, basi acuta. Pedunculi solitarii uniflori, bracteola mediana. Petala exteriora lineari-lanceolata pollicaria, interiora parum longiora angustiora. Stamina obpyramidalia. Ovula pauca subuniseriata. Baccæ stipitatæ parvæ breviter cylindricæ leviter constrictæ apiculatæ, seminibus 1–5 globosis compressis.

Shrub 6–9^{ft} high. Leaves distichous with very short internodes, 3–4 × $1\frac{1}{4}$–$1\frac{1}{2}^{in}$, paler beneath, petioles $1\frac{1}{2}^{l}$ long. Peduncles opposite to leaves, 5–7^{l} long, in fruit twice longer; bracteole ovate-lanceolate, 4^{l} long. Perianth pubescent, fuscous, membranaceous, 3–5-nerved; sepals ovate-lanceolate; exterior petals 3^{l} broad, the interior 14–15 × 2^{l}. Stamens subsessile, $\frac{1}{3}^{l}$ long, the dilated incurved apex of connective nearly as broad. Carpels 8–11, oblong, $\frac{1}{2}^{l}$ long, pilose, sessile on truncate apex of hemispherical torus, ovules 4–7, the middle ones occasionally biseriate. Berries 3–4, 9–11 × 5^{l}, the interior ones often globose and 1-seeded, stipe 1–2^{l} long, seeds 4^{l} in diameter, longitudinally encircled by a groove.—*Porcelia Nicaraguensis* Benth. (represented in the series of *exsiccatæ* by nos. 474, 4,508, 4,519, 5,041), remarkable by petals 4–5^{in} long, presents a similar structure of flowers, but the seeds are biseriate and numerous.—Shores of Rio Ocosito, Depart. Quezaltenango, Guat., alt. 300^{ft}, Apr. 1892, J. D. S., no. 1,484.

Cymbopetalum stenophyllum Donnell Smith.—Absque pistillis glaberrimum. Folia anguste oblongo-lanceolata longiuscule acuminata ad basim acutam inaequilatera membranacea pellucido-punctula, petiolis brevissimis. Pedunculus folio aut summo aut pænultimo oppositus ab eoque ter quaterve superatus. Petala interiora magna ovalia quasi calceiformia, exteriora triente minora orbiculari-ovata. Stamina brevia. Pistilla numerosa, stigmate oblique bivalvato uncinato.

A shrub 12–15^{ft} high. Leaves distichous, 6–7 × $1\frac{1}{2}$–$1\frac{3}{4}$^{in}. Peduncle erect, 1–$1\frac{1}{2}$^{in} long, ebracteolate. Flower $2\frac{1}{2}$^{in} in diam. Sepals minute, broader than long. Petals glabrous, virescent, transversely wrinkled; the exterior membranaceous, plane, 8–9^{l} long, apiculate; the interior fleshy, 12–14 × 10–11^{l}, very concave, the inflexed margins 3–4^{l} broad. Stamens 2^{l} long, filament minute, gland-dilated apex of connective nearly glabrous. Torus hemispherical. Carpels 16–18, linear, compressed, with the nearly as long style added a little exceeding stamens, 5–6 ribs pubescent; stigma puberulous, bent back at apex; ovules 6–9. Berries not seen.—Banks of Rio Ocosito near Caballo Blanco, Depart. Quezaltenango, Guat., alt. 250^{ft}, Apr. 1892, J. D. S., no. 1,491.

CAPPARIS HEYDEANA Donnell Smith, in BOT. GAZ. **18:** 197. 1893. (*Char. amplif.*).—Glaberrima. Folia ellipticovel obovato-oblonga 5–9-pollicaria utrinque acuminata, petiolis canaliculatis pollicaribus. Flores pauci in racemo terminali brevissimo dispositi, pedicellis petiolos æquantibus. Petala magna obovato-spathulata sepalis oblongis obtusis 8–10-linearibus in anthesi caducis triplo longiora. Stamina 6 cum carpophoro æquilongo petala pæne æquantia. Ovarium spurie 2-loculare, disci glandulis distinctis triangularibus. Bacca oblonga pollicaris carpophori dimidium æquiparans continua subtetragona parce verrucosa 4-locularis, loculamentis superpositis monospermis. PLATE I.

The additional characters are drawn from more complete specimens collected by M. Adolph Tonduz in Talamanca, Costa Rica, little above sea-level, Mch. 1894 (no. 8,528).[1]

[1] An exploration of the flora of Costa Rica upon a more extended scale than has heretofore been attempted in any part of Central America is now being prosecuted by MM. Pittier de Fábrega and Tonduz. The *exsiccatæ*, containing already some 9,000 numbers, serve as the basis of *Primitiæ Floræ Costaricensis*, a publication by MM. Durand and Pittier, assisted by various collaborators.

ZANTHOXYLUM LIMONCELLO Planch. et Œrst. To this species, which had been overlooked, must be referred the plant described as *Z. Costaricense* in BOT. GAZ. **13:** 190. 1888. It is represented in the series of *exsiccatæ* by nos. 4,755, 5,726.

Picramnia quaternaria Donnell Smith. — Pubescens. Foliola 9–15 plerumque dissociata glabra supra nitida elongato-lanceolata in apicem obtusum vel retusum sensim angustata præter terminale ad basim valde inæquilatera, ima immutata. Racemi terminales gemini simplices vel parce ramosi, pedicellis gracilibus fasciculatis, floribus 4-meris. Ovarium glaberrimum 2-loculare. Bacca nitida ovalis monosperma semine obovoideo, interdum bisperma seminibus plano-convexis.

Tree 20–30^{ft} high. Leaves 6–8^{in} long, petioles 1–2^{in} long and like rachis puberulous; leaflets 2–3^{in} × 7–10^{l}, approximated in pairs or chiefly scattered, oblique, base somewhat rounded on upper side with the lower narrowly cuneate; petiolules puberulous, 1½^{l} long, the terminal twice longer. Racemes pubescent, equalling leaves, one in the pair usually with 1–3 branches; pedicels glabrous, chiefly 4–6-umbellate, 2^{l} long. Sepals ovate, aureo-pubescent, a rudimentary fifth one occasionally present. Petals lanceolate, 1^{l} long, thrice exceeding sepals, twice exceeding staminodes. Ovary shorter than petals; stigmas recurved, occasionally three. Berry 5–7 × 3–4^{l}, equaling pedicel; racemes densely fruited. Staminate flowers not seen. The single other species described with 4-merous flowers, *P. tetramera* Turcz., imperfectly characterized, appears to be represented by no. 8,492 Tonduz *Pl. Costaricenses* (fruited specimens with persistent sepals); it differs from the above by indument, less elongated contractedly acuminated leaflets pubescent beneath, the lower pair ovate and equilateral, axillary simple racemes, less densely fruited, obovate-ellipsoid pubescent berry, compressed seed.

Slopes of Volcán Fuego, Depart. Zacatepéquez, Guatemala, alt. 6,000^{ft}, Mch. 1892, J. D. S., no. 2,562. Jumaytepeque, Depart. Santa Rosa, Guat., alt. 6,000^{ft}, Mch. 1892, Heyde & Lux, no. 4,332. Buena Vista, Depart. S. Rosa, alt. 5,500^{ft}, Nov. 1892, Heyde & Lux, no. 4,333.

TRICHILIA SPONDIOIDES Sw., var. **gibbosifolia** C. DC.— Foliolis basi leviter inaequilateris latere longiore rotundatis.

Santa Rosa, Depart. S. Rosa, Guat., alt. 3,000^{ft}, Mch. 1893, Heyde & Lux, no. 4,453.

CUPHEA EPILOBIFOLIA Koehne, var. **canescens** Koehne.—Folia juniora pilis parallele adpressis densissimis incana, mox infra, demum supra glabrescentia. Pedicelli intrapetiolares. Ovarium villosum, stylus ovarii circ. 3-plum æquans. Cetera ut in var. Costaricensi Koehne.

Banks of Rio Jiménez, Llanos de Santa Clara, Comarca de Limón, Costa Rica, alt. 650ft, Apr. 1894, J. D. S., no. 4,807.

Homalium Hondurense Donnell Smith (§ RACOUBEA Benth. in Journ. Linn. Soc. **4:** 33.).—Folia nitida obovato-elliptica subito acuminata, basi acuta, margine crenato. Racemi axillares, etiam in paniculam terminalem laxam dispositi, floribus canescentibus 5–7-meris, supremis solitariis pedicellatis, inferioribus autem ternis graciliter pedunculatis. Calycis tubus pedicellis brevior, segmentis quam petala dimidio brevioribus triploque angustioribus. Stamina terna. Ovarium hirsutum in stylos 3 distinctos longe productum.

Tree 30ft high. Leaves 6–7 × 3–3½in, thin-coriaceous, veiny, coarse crenatures glandular, petioles 2–3' long. Racemes pubescent, equaling leaves, peduncles 5–7' long, pedicels 2–4' long, flowers chiefly 5-merous. Calyx-segments obtuse, equaling tube. Petals 2½–3 × 1–1½'. Ovary equaling petals, styles very short, ½', ovules 3 to each placenta.—Flowers about as large as those of *H. racemosum* Jacq., which differs chiefly by leaves, simple racemes, calyx-segments nearly equaling petals, slightly produced ovary. *H. pedicellatum* Spruce (no. 1,689 Spruce!) with similar inflorescence is distinct by foliage, large flowers, quinate stamens, etc.—Rio Permejo near San Pedro Sula, Honduras, alt. 600ft, Sept. 1887, Dr. C. Thieme, no. 5,227.

Centropogon Guatemalensis Robinson.—Glabrous: stems flexuous: leaves ovate-oblong, acuminate at each end, commonly oblique at the base, crenate and denticulate, 4–7in long, 2¼–3in broad; teeth very small, inconspicuous, incurved, acutish, glandular; midrib prominent upon both surfaces but much broader upon the under side; lateral nerves 7–9 pairs, widely spreading and strongly curved; terminal acumination rather abrupt and the point slender; petioles strongly compressed laterally and finely grooved above, 1–2in long: raceme subcorymbose with 8–12 or more flowers; bracts oblong, acutish, denticulate, 4–7' long; pedicels spreading, curved-ascending, the lower ones 1½–2in long: calyx tube hemispher-

ical, slightly exceeding the adnate ovary; teeth ovate, obtusish, denticulate, purplish, 2–2½' long, about equaling the tube: corolla in a dried state deep purple, 2¼'' long, cleft more than a third of the way to the base, usually granular-pubescent both upon the outer and inner surface: stamineal column about equaling the corolla, covered especially down one side with short blunt white hairs; the two smaller anthers densely tufted at the apex and with smaller spreading tufts at the base; the other anther cells sparingly hispid at the apex: fruit not seen.—Pansamalá forest, Depart. Alta Verapaz, Guat., alt. 3,800ft, June 1885, von Türckheim, no. 728.

Cavendishia callista Donnell Smith.—Omnibus in partibus praeter corollam glaberrima. Folia oblongo-ovata vel ovato-lanceolata acutissime acuminata ad basim leviter cordata 5–7-plinervia subtus sparsim nigripunctula. Racemi subterminales elongati, pedicellis gracilibus. Calyx corollæ dimidium fere aequans, limbo campanulato ovarium altero tanto superante usque ad medium fisso. Stamina valde dimorpha.

Branchlets reddish, terete, estriate, somewhat flexuous. Leaves thick-coriaceous, 4–8 × 2–3½''; nerves prominent beneath, the interior pair ascending from near base to apex; petioles 4–5' long. Racemes geminate at apex of branchlets and single in uppermost axil, 4–5'' long, exceeding subtending leaves; basal bracts orbicular, the interior 9–11' in diam.; rachis angulate, densely flowered; pedicels 5–6' long, basal bracts obovate, 9–12 × 4–6', half covering flowers; bractlets at middle of pedicel 2, lanceolate, 1' long; bracts and bractlets roseate, in anthesis persistent. Calyx 4–4½' long; tube angulate, intruded at base; segments ovate, 1½' long, acute tips coloured. Corolla cylindrical 10 × 3', puberulous, white, ovate lobes 1' long. Stamens connate at base, reaching to throat of corolla; larger anthers a half longer than the others with cells half as long as tubes and twice longer than filament, cells of smaller anthers nearly equaling tubes and half as long as filament. Berry (immature) glabrous.—Distributed as *C. pubescens* Hemsl. ? That species (nos. 290, 1,383 Bang *Pl. Boliv.* !; and nos. 3,184, 4,532 of this series) may be distinguished by indument, narrower leaves, short racemes, calyx-tube exceeding limb, nearly similar stamens, cano-hirsute berry.—Forests between Coban and Samac, Depart. Alta Verapaz, Guat., alt. 4,500ft, May 1886, von Türckheim, no. 941.—PLATE II.

Napeanthus apodemus Donnell Smith.—Caulis subnullus, foliis rosulatis obovato- vel oblongo-spathulatis integris ab initio glabris. Pedunculi in axillis singuli, floribus parvulis. Calyx fere partitus, tubo 5-alato, laciniis elongato-lanceolatis haud reticulatis. Corollæ subrotatæ tubus brevissimus prope basim zona purpurea notatus, lobi inaequales bis terve longiores. Stamina 3–4 cum alius rudimento. Capsula ovoidea cum stylo breviori adjecto calycem æquiparans.

Rhizome very short, fibrillose. Leaves alternate, sessile, semiamplexicaul, 3–4^{in} × 10–15^{l}, oblique, obtuse, membranaceous, granular-punctulate, 5–6 lateral nerves ascending to margin, reticulating veins invisible on pale undersurface. Peduncles 1–2^{in} long; panicles slender, dichotomous, surpassing leaves; bractlets pubescent, linear, 2–3^{l} long; pedicels 4–8^{l} long. Calyx pubescent, in fruit glabrate and 2¼ × 1¼^{l}, minute wings decurrent from sinus to pedicel, segments 3-nerved. Corolla seen only before anthesis. Filaments very short; anther-cells oblong, diverging, distinct.—Of the other three described species, all South American, *N. Brasiliensis* Gardn. and *N. primulina* Benth. et Hook., *ex char.*, differ chiefly by developed stem, large leaves and flowers; *N. subacaulis* Benth. et Hook. (no. 2,506 herb. Bot. Gard. Trinidad!), imperfectly described, is distinguished by pointed leaves, larger and less deeply parted calyx, spherical capsule equaling style; and all differ by serrate and more or less pilose leaves, reticulated segments of wingless calyx. *N. Andina* Rusby *ined.* (no. 1,729 Bang *Pl. Boliv.!*) is remarkable by its campanulate tube of corolla exceeding the lobes.—Shaded precipitous banks of Rio Jiménez, Llanos de Santa Clara, Comarca de Limón, Costa Rica, alt. 650^{ft}, Apr. 1894, J. D. S., no. 5,109.

Arrabidæa dichasia Donnell Smith.—Folia bifoliolata, cirrho caduco, foliolis obovato-ellipticis abrupte acuminatis ad basim imam acutis coriaceis nitidis utrinque reticulato-nervosis, costis in utroque latere 4–5, petiolis cum petiolulis fere aequilongis brevibus. Thyrsi terminales ampli, ramis pluries dichotomis. Calyx campanulatus minutissime glandulo-lepidotus subinteger saepius laceratus. Corolla velutina supra calycem dilatata longe infundibuliformis, limbi obliqui lobis obovatis. Filamenta brevia. Discus pulvinatus. Ovula numerosa.

Scandent (Thieme). Petioles 6–8^{l} long, petiolules 5–7^{l}; leaflets 4–5 × 2–2½^{in}, lateral nerves ascending to near margin.

Thyrsus broad, 8–10^{in} long; peduncle $1\frac{1}{2}$–3^{in} long; axes puberulous, minutely lepidote, the secondary 1–$1\frac{1}{2}$^{in} long. Calyx as broad as long, 3^{l}, occasionally with a few large glands. Corolla $2\frac{1}{4}$–$2\frac{3}{4}$^{in} long; tube nearly cylindrical, at middle 6–7^{l} broad, smooth within except paleaceous-barbate insertion of stamens at contracted base; lobes puberulous within, as broad as long, 7–9^{l}, contracted below. Stamens didynamous; filaments arcuate, 8–10^{l} long; anther-cells divaricate, 2^{l} long, connective round-apiculate. Ovary linear; lobes of stigma elliptical, 1^{l} long; ovules uniseriate at each placenta, 25–30 pairs to the cell. Capsules not seen.—According to the synoptical arrangement of species by Schumann in Engl. & Prantl *Nat. Pflanzenfam.* the above is to be grouped with *A. Chica* Bur. The leaves and inflorescence resemble more nearly those of *Distictis elongata* Bur. The whole plant becomes blackened as an *exsiccata*.

Sandy grounds near San Pedro Sula, Honduras, alt. 600^{ft}, May 1890, Dr. C. Thieme, no. 5,393.

ARRABIDÆA CHICA Bur., var. **viscida** Donnell Smith.—Folia trifoliolata, foliolis supra strigillosis subtus velutinis cuspidato-acuminatis, lateralibus quidem e basi oblique cordata 5-nervia orbiculari-ovatis, medio maximo e basi rotundata 3-nervia orbiculari-obovato interdum in cirrhum immutato lateralibus tunc ovato-lanceolatis. Paniculæ et terminales et axillares cum calycibus glandulo-viscidæ.

Casillas, Depart. S. Rosa, Guat., alt. 4,000^{ft}, May 1893, Heyde & Lux, no. 4,550.

Distictis Rovirosana Donnell Smith.—Folia recentiora stellato-canescentia, adulta praeter petiolos longos et nervos glabrata, foliolis oblongo-obovatis ad formam ovalem vel oblongo-ovatam ludentibus caudato-acuminatis, basi 3–5-nervia plerumque retusa. Thyrsi incani angusti foliis recentioribus bracteati in paniculam terminalem amplam dispositi, cymulis 3-chotomis. Calyx anguste campanulatus, dentibus mucronatis. Corolla recta campanulato-infundibuliformis. Discus latior quam altior. Ovula in utraque placenta 4-seriata. Capsula ecarinata glandulis magnis maculata ceterum glabra, seminibus in utroque loculo 15–18.

Trunk very stout, procumbent; branches scandent, striate, glandular-pubescent. Petioles 2–4^{in} long; leaves 3-foliate, or conjugate with a simple tendril, 4–6 × $2\frac{1}{2}$–3^{in}; terminal petiolule $\frac{3}{4}$–$1\frac{1}{4}$^{in} long, 2–3 times exceeding the lateral. Thyrsi

stellate-tomentulose, often undeveloped and corymbiform; bractlets linear, 2–4^{l} long. Calyx velvety, $2\frac{1}{2}$–3^{l} long. Corolla velvety, roseate, $1\frac{3}{4}$–2^{in} long; contracted tube twice exceeding calyx, pubescent within; lobes subequal, subovate, 7–9^{l} long, pubescent within. Stamens inserted at contracted base of corolla, nearly attaining throat, anther-cells divaricate. Disk $\frac{1}{2}^{l}$ high, twice broader, somewhat cupulate. Ovary oval, lepidote, ovules 7–9 in each series. Capsule ligneous, oblong, $3\frac{3}{4} \times 1\frac{1}{2}^{in}$, acuminate, base rounded, valves thick, septum marked near margins with irregularly biseriate linear hila; seeds pubescent, suborbicular, 7–9^{l}, with wing added oblong and 2×1^{in}.—Very distinct from *D. elongata* Bur. and *D. Mansoana* Bur. (no. III, 50 ex herb. Brasil. Regnell. !), the only species that have been referred to *Distictis* as limited by Bureau.

Collected by Prof. José N. Rovirosa "in clivulis prope Atasta, Tabasco, Mexico, ubi vernacule *Pié de Gallo* dicitur, Maj. 1889, n. 488 Flora Mexicana." Also represented in this series: Obero, Depart. Escuintla, Guatemala, alt. 200^{ft}, Mch. 1892, J. D. S., no. 2,689: Papelón, Depart. Choluteca, Honduras, near sea-level, Feb. 1893, Shannon, no. 5,052: Rio Limón, Depart. Rivas, Nicaragua, near sea-level, Apr. 1893, Shannon, no. 5,053: Rio Sapoá, Depart. Rivas, Nicaragua, alt. 650^{ft}, Apr. 1893, Shannon, no. 5,054.

Tecoma evenia Donnell Smith.—Folia ampla minutissime lepidota ceterum glabrata 5-foliolata, petiolis petiolulisque semiteretibus, foliolis ellipticis acutis ad basim obtusis penninerviis, venis utrinque immersis. Thyrsi corymbiformes subhemispherici densiflori, axibus perbrevibus et calycibus rufotomentosis. Calyx obconicus, dentibus subaequalibus rotundatis mucronatis. Corolla supra calycem sensim ampliata longe infundibuliformis intus unilateraliter pubescens $\frac{1}{3}$-lobata, lobis obovatis pollicaribus punctulis.

Tree 25–30^{ft} high. Petioles 6–7^{in} long; leaflets coriaceous, the interior $5–7 \times 2\frac{1}{4}$–$3\frac{1}{4}^{in}$ with half as long petiolules, the exterior a half smaller with petiolules 5–7^{l} long; costæ to a side 8–10, very prominent beneath, straight, uniting in submarginal arches. Thyrsus sessile at apex (often furcate) of branches, 8–9^{in} broad, half as high; secondary axes subfasciculate, 4–5^{l} long, 3-chotomous, capitulate hairs glandular. Calyx 6–7^{l} long, exceeding pedicel. Corolla apparently roseate, 3^{in} long; tube below throat 6–8^{l} wide; lobes finely reticu-

late. Stamens half as long as tube of corolla; anther cells divaricate. Disk annular. Ovary linear; lobes of stigma obovate, 1' long; ovules irregularly pluri-seriate to the cell. Capsule not seen.—Leaves and inflorescence are very similar to those of *Couralia rosea (Tecoma rosea* Bertol.; *Tabebuia rosea* DC., § COURALIA), represented in the series of *exsiccatæ* by nos. 3,111, 4,912, 5,047, 5,388. That species differs by glaucous veiny leaflets, glabrous inflorescence, bilabiate calyx, uniseriate ovules to the placenta; the last character and the loculicidal dehiscence of capsule, *ex descr.*, seem to warrant its transfer to *Couralia.*

Santa Rosa, Depart. Santa Rosa, Guat., alt. 2,500ft, Mch. 1892, Heyde & Lux, no. 3,110.

DURANTIA MUTISII L., var. **Costaricensis** Donnell Smith.—Rami cum inflorescentia tomentulosi flavescentes, foliis subtus sordide pubescentibus supra puberulis, bracteis foliaceis stipitatis infimis florem superioribus calycem æquiparantibus.

Shrub 10–20ft high, growing in cultivated grounds at Estrella, Prov. Cartago, Costa Rica, alt. 4,400ft, Apr. 1888, Juan J. Cooper, no. 6,007.—This may be presumed to be the undetermined species noted by Polakowsky (Die Pflanzenwelt von Costa Rica, p. 97) as occurring not far from the above locality.

CHAUNOSTOMA Donnell Smith, nov. gen. LABIATARUM.—Calyx obpyramidalis irregulariter plurinervis usque ad medium bifidus, lobis 5 subæqualibus triangularibus, fructiferens auctus. Corolla parva quasi oblonga, tubo breviter exserto, faucibus obliquissimis, labii postici erecti lobis semirotundis, antici longioris sub angulo nullo fere dejecti lobis lateralibus in marginem arcuatam declinatam reductis, lobo medio patente concavo integro. Stamina 4 didynima ascendentia longissime exserta, antica eminentiora, antherarum locellis divergentibus confluentibus. Discus crassus æqualis. Ovarium usque ad basim partitum, stylo staminibus æquilongo breviter bifido, lobis subulatis æqualibus. Nuculæ ovales leves, areola minuta oblique basali.—Inflorescentia axillaris simpliciter racemosa, pedicellis oppositis ad basim bracteatis in medio bibracteolatis unifloris.

Genus ob anomalam characterum conjunctionem sedem in systemate incertam occupat. Nomen inditum corollam latissime hiantem dicere vult.

Chaunostoma mecistandrum Donnell Smith.—Frut ex orgyalis incanus stellato-tomentosus, internodiis brevissim

Folia crassa discoloria supra rugosa subtus dense velutina penninervia crenulata oblongo-elliptica vel oblongo-lanceolata utrinque acuta. Racemi a foliis bis terve superati, pedicellis calycem caeruleum aequiparantibus.

Leaves 5–6½ × 1½–2^{m}. Petioles 6–9^{l} long, equalling or exceeding internodes. Bracts and bractlets linear. Calyx bright-blue, 4^{l} high, in fruit twice larger. Corolla (red ?) like calyx pubescent and aureo-punctulate, 7½^{l} long, posterior lip 2^{l} long and nearly equaling the arcuate sides of anterior lip, middle lobe 1^{l} long. Stamens twice exceeding corolla, after anthesis declinate and contorted, anther-cells oblong and blue. Nucules black, shining, 1^{l} long.—The racemes, as shown by presence of bractlets, are technically undeveloped thyrsi.—Growing in patches on shaded mountain-summits near Buena Vista, Depart. Santa Rosa, Guat., alt. 6,000^{ft}, Dec. 1892, Heyde & Lux, no. 4,368.—PLATE III.

Ocotea perseifolia Mez et Donnell Smith; foliis adultis subtus pilis brevissimis perobscurisque scabriusculis, late ovato-ovalibus, basi cordatis v. obtusis apice late breviterque acuminatis, penninervibus, utrinque laxe prominulo-reticulatis; inflorescentia submultiflora, abbreviate subthyrsoidea, foliis multo breviore; floribus hermaphroditis, minutissime peradpresseque tomentellis; perianthii tubo brevi; antheris subsessilibus; staminodiis fere abortivis; ovario glabro; stylo brevi.

Arbor v. frutex; habitu ramuli praesentis *Perseæ caeruleæ* memoriam revocat. Ramuli praesertim apicem versus ± angulati, peradpresse paullo sericanti-tomentelli flavido-allutacei. Folia petiolis usque ad 20^{mm} longis, optime canaliculatis stipitata, sparsa, coriacea, sicca supra olivaceo-viridia subnitida subtus pallida opaca, usque ad 0.2^{m} longa, 0.12^{m} lata, venis dorso ± manifeste rubentibus. Inflorescentia peradpresse pallide tomentella; pedicellis ±2^{mm} longis, bracteolis deciduis. Flores 3–3.5^{mm} longi, limbi tubo obconico, segmentis ovalibus, acutiusculis, papillulosis. Antheræ rectangulares, rotundatæ vel truncatæ, papillosæ; glandulæ ser. III. parvæ, globosæ, sessiles, basales. Ovarium crasse ovoideum, stylo 5–6-plo breviore, stigmate obtuso. Fructus ignotus.

Yzabal, Depart. Yzabal, Guat., alt. 120^{ft}, Apr. 1889, J. D. S., no. 1,807.

Dioscorea cyanisticta Donnell Smith. (§ALLOCTOSTEMON Griseb. in Fl. Bras.).—Absque rhachibus glabra. Folia cordiformia acuminata 11-nervia. Spicæ in axillis aggregatæ,

in panicula evoluta singulæ, flaccidæ, rhachibus complanatis, glomerulis distichis, floribus subsessilibus binis aut ternis parvulis. Stamina a segmentis patulis perianthii partiti triplo superata staminodiis filiformibus puberulis aequilonga, locellis discretis. Ovarii rudimentum nullum.

Stem stout, procumbent, branchlets twining. Younger leaves ovate-lanceolate from an acute or rounded base; the mature as broad as long, 5–6 , more or less acuminated, sinus broad and shallow, twice to thrice exceeding petioles, membranaceous, pellucid-lineolate, spotted beneath toward base with numerous large blue glands. Spikes subsessile, 4–6^{in} long, rachis puberulous, clusters approximated; flowers minutely pedicellate, occasionally solitary, equalling elongate-lanceolate bract. Perianth $1\frac{1}{2}^{l}$ in diam.; segments oblong, obtuse, 1-nerved. Filaments inserted at base of segments, little exceeding anthers. Feminine spikes not seen.—Growing over rocks along shores of Rio Turrialba, Prov. Cartago, Costa Rica, alt. 1,600^{ft}, Mch. 1894, J. D. S., no. 4,969.

Baltimore, Md.

EXPLANATION OF PLATES I–III.

I. *Capparis Heydeana.*—Fig. 1, flowering branch.—Fig. 2, carpophore with ovary.—Fig. 3, section of ovary.—Fig. 4, sepal.—Fig. 5, petal.—Fig. 6, stamen.—Fig. 7, carpophore with berry.—Fig. 8, section of berry. (Figures 3 and 8 are somewhat enlarged; the others are natural size.)

II. *Cavendishia callista.*—Fig. 1, flowering branch.—Fig. 2, interior bract subtending raceme.—Fig. 3, bract subtending pedicel.—Fig. 4, flower with pedicel.—Fig. 5, section of flower with corolla removed.—Fig. 6, corolla laid open.—Figs. 7 and 8, stamens. (Figs. 1–4 are natural size; the others are somewhat magnified.)

III. *Chaunostoma mecistandrum.*—Fig. 1, flowering branch.—Fig. 2 calyx laid open with pistil.—Fig. 3, corolla in profile with stamens.—Fig. 4, corolla laid open with stamens.—Fig. 5, an anther.—Fig. 6, disk with ovary.—Fig. 7, nucule. (Figures 1 and 2 are natural size; the others are variously enlarged.)

Notes from my herbarium. I.

WALTER DEANE.

A few notes from my herbarium, relating to some of the plants which I have collected from time to time, may be of interest. Roots, runners, rootstocks and the like are rarely well represented in collections, and yet how incomplete the plant is without these characteristics, and what important functions they often fulfil in the economy of nature.

LATHYRUS MARITIMUS Bigelow. Beach pea.

I have a specimen of this species, represented on three sheets. I collected it on Aug. 31, 1888, at Hyannisport, Mass. It was growing in the clear sand near the water, and its importance in helping to bind the sands, and thus to resist the ever-encroaching waves of the sea, can be seen from the following note which I made at the time, and copied on one of the sheets: "The main rootstock of this plant was nineteen feet long. The stock ran along but a few inches, from one to four, under the sand. The nodes of the rootstock were from six inches to one foot apart. At intervals of from one to three feet, short roots were thrown off from the stock at the nodes. There were three branches from the main stock, the longest one being six and one-half feet. These branches were also branching. The fresh young stocks were very white, succulent and brittle. The root descended abruptly two and one-half feet, branching slightly at the end. From the stocks rose eight fresh plants, and three dead stalks of last year's plants." This is certainly a most astonishing record for a single plant. I retained for my herbarium enough of the plant to show all its features, even including the nineteen feet of rootstock. By coiling the stock, I easily managed it. It is about one-eighth of an inch thick, and makes a flat mat, which is readily mounted.

AMMOPHILA ARUNDINACEA Host. Sea sand-reed.

On Aug. 13, 1886, at Rye Beach, N. H., on a sandy beach, I dug up a complete tussock of this tough grass. By a judicious cutting off of the top of the plant, leaving enough to show a few leaves and the inflorescence, and by using a very heavy pressure, a fine specimen was made, showing the size

of the plant, with its copious roots and running rootstocks complete. I find this a most satisfactory way of showing the character of the plant. The stocks are tough, wiry, and about a foot long. A specimen like this can easily be supplemented by other specimens, showing individual parts separately.

The character of this grass as a binder of the sea sand is well known. When the ever-shifting sands bury the plant a foot deep or more from its base, it appears as usual the next year, the new plant connected with its buried parent by a tough brown stem one-sixteenth of an inch in diameter, looking exactly like a wire, and rising straight from the center of the old plant. I have a plant from Nantasket Beach, Mass., showing this peculiarity.

RANUNCULUS CYMBALARIA Pursh. Sea-side crowfoot.

This species of crowfoot grows by the sea in various kinds of soil. The average height of the scape is from four to six inches. I have a vigorous plant from the Charles river salt marshes in Cambridge, with a scape eleven inches high. A most interesting feature of the plant is its long rooting runners. It is not always that these runners have a chance to display their greatest activity. When growing amongst other plants, such as grasses and the like, the plant seems to reach a greater development, but the runners have little chance to display themselves. On July 20, 1894, at Wells, Me., I found this plant growing in a ditch of soft black mud. It covered a space of a few square yards, and was literally yellow with flowers. No other plant of any kind hindered its growth and the runners were interlaced in every direction. I took up a single plant with six runners attached. The longest runner was two feet one inch long, and rooted eight times. The plant rooting at the first node was fully developed, bore a flower, and was sending forth a secondary runner which had already rooted twice. Another runner rooted seven times, the first plant bearing a bud, while the smallest runner rooted three times. The parent plant was small, the scape being barely three inches high, as if its numerous progeny had sapped its strength. By careful manipulation I arranged the plant so that it would come within the limits of a mounting sheet, without crowding the runners. It tells a most interesting story of rapid propagation.

ARALIA NUDICAULIS L. Wild sarsaparilla.

I find in my herbarium a fruiting specimen of wild sarsaparilla, which I collected July 19, 1883, in Shelburne, N. H., among the White mountains. The tough perennial root, one fourth of an inch in diameter, ran horizontally a few inches below the surface in opposite directions from the main stem. I dug it up till it broke, and on measurement found that I had a root eight and one half feet long. By coiling the two ends up to the stem, I easily made a good mounting specimen, which shows that far the greater part of the plant is under ground. It takes a separate mounting sheet to show one of the three divisions of the large compound leaf. Smaller specimens show the whole leaf of various sizes. Beside this large specimen I have put a very young plant, collected May 12, 1883, in Belmont, Mass. The scape is two inches, and the leaf three inches high.

GALIUM ASPRELLUM Michx. Rough bedstraw.

This species of bedstraw, which grows throughout the Gray Manual range, has a fine development of root-stock. I collected a specimen Sept. 6, 1889, in E. Jaffrey, N. H., and it takes an entire mounting sheet to show the underground growth. The root-stocks branch very freely from the stem, the longest one being two feet. They run along but a short distance under the surface of the ground, and root copiously at the nodes, which are about one inch apart. Young plants are sent up occasionally from the nodes. On my single specimen I count fifteen of these plants, varying from less than an inch to five inches in length.

ASTER ACUMINATUS Michx.

In a deep, rich wood at Rye Beach, N. H., Aug. 19, 1886, in company with *Woodwardia angustifolia* Smith, which was extremely abundant, I found this aster growing in the greatest profusion. It reached a perfect development here, for the plants ran as high as two and one-half feet. I took up a specimen which showed very beautifully the slender underground stems, connecting different plants. From a rootstock several inches below the surface, three rootstocks branched at intervals of about an inch. Each of these stocks, which were all fifteen inches in length, bore a vigorous plant, the one which I retained for my herbarium being two and one-

half feet high, with leaves seven inches long. The other specimens of this species in my herbarium are of the average size, from one and one-half to two feet high, with leaves about four inches long. Twenty shoots, from fifteen inches to less in length, branch off from the three stocks. All this tangle of rootstock I have mounted on one sheet, with about three inches of the stems of the three plants, mounting on a separate sheet the flowering specimen which I retained.

TARAXACUM OFFICINALE Weber. Common dandelion.

I have succeeded in mounting a specimen of our common dandelion with the large head of fruit intact. I did it in this way. I collected the specimen the moment the fruit had opened, and while the akenes were still firmly attached to the receptacle. In this condition I pressed it. By the time the plant was dry, I noticed that the akenes were free from the receptacle, but still in position. I always transfer all my plants too flimsy to handle to the mounting sheet or pasting sheet of blotting paper by reversing the plant with a sheet on each side. This saves much trouble, and the most delicate plants can in this way be very quickly handled and mounted. In the case of my taraxacum, however, I could not touch the pasting brush to the pappus on the fruit, as it would stick to it and spoil my specimen. So when the plant was on the mounting sheet unpasted, I made a few points with a pencil close to the edge of the pappus. Then, after transferring the plant to the pasting sheet, I pasted all the plant but the fruit, and, on the mounting sheet, I pasted the space between the points. By careful reversal of the plant again, the fruit fitted exactly on the former spot, where the glue received it and held it fast. A few blotters and a proper weight, laid on the sheet for a few hours, completed the work.

Cambridge, Mass.

The crystallization of cellulose.

DUNCAN S. JOHNSON.

Previous investigation.

In number two of volume nine of *La Cellule*, Eugene Gilson of the University of Gand has an interesting article on "The crystallization of cellulose and the chemical composition of the cell membrane of plants."

I will give an abstract of the article and then have something to say of some work in the same line done in the winter and spring of 1894 in the biological laboratory of Johns Hopkins University.

The author first sets forth the present state of our knowledge of the constitution of the cell wall, taking the work of Schultze as the most authoritative. Schultze holds that we have in the cell wall dextrocellulose and mannosocellulose. These two agree in being insoluble in dilute acids or alkalies by boiling and in their coloration by iodine and sulfuric acid, but differ in their derived sugars, the first giving only dextrose and the second both dextrose and mannose. Besides these he proposes to give the name of hemicelluloses to those as yet little known compounds occurring in the cell wall that are soluble in dilute acids and alkalies by boiling, and which probably agree with dextrocellulose and mannosocellulose in their reaction with chloriodide of zinc and iodine and sulfuric acid.

None of these bodies, though closely related to the crystalline sugars, have hitherto been considered to be crystalline but rather amorphous.

Gilson hoped to settle the following points: (*a*) Which of the carbohydrates is it that crystallizes from a solution of the material of vegetable tissue in Schweizer's reagent, when strong ammonia is added? (*b*) Is cellulose a distinct chemical individual or are there several compounds in the cell wall that are insoluble in dilute acids and alkalies, and give the blue color with the iodine reagents? (*c*) Is the cellulose free or in combination in the cell membrane with other constituents? (*d*) Is the cellulose distributed through all three layers of the cell membrane or localized in one or two or in certain parts of all?

In his discussion the author uses the term cellulose to designate provisionally the carbohydrate or carbohydrates of the cell wall that are insoluble in acids and alkalies and give the blue color with iodine and sulfuric acid.

For the author's method of obtaining the so-called crystals of cellulose, we may describe the course pursued for the root of the beet (*Beta vulgaris*), which is only modified in individual cases depending upon the resistance of the tissue at hand. Moderately thick sections of the swollen root were — (1) soaked in 1% KOH (or eau de javelle) to dissolve out the cell contents. In repeating his experiments in the Johns Hopkins laboratory half an hour in 1.5% KOH was generally found sufficient. (2) After thoroughly washing in distilled water the sections were put into Schweizer's reagent for four or five hours. (3) The dissolved cellulose is precipitated in crystals by putting the sections after removal from Schweizer's reagent into ammonia, the size of the crystals being said to vary with the strength of the ammonia, 5% giving only spherocrystals, and 20% giving beautiful arborescent or radially arranged spicular crystals.

These bodies, which have the appearance of crystals under the microscope, can be seen best after clearing the sections of copper compounds by washing them with water and treating with dilute HCl and then coloring them with chlor-iodide of zinc (or Congo red before treatment with HCl). They are then found almost entirely within the cell walls, sometimes in the intercellular spaces, those that are formed outside being from the cells opened in cutting the section, very little of the dissolved cellulose diffusing through the cell wall. If the Schweizer's fluid has acted long enough the iodine reagents give no evidence of any cellulose remaining in the cell membrane, the only blue coloring substance being the crystals within the cell cavity.

It is from the beet evidently that Gilson gets his most characteristic crystals, as it is these that he figures for his article, though he has worked in this way upon sections of more than fifty plants. Most of these are angiosperms, but among them are chara and spirogyra of the algæ, and mucor and agaricus of the fungi, with half a dozen mosses and ferns and two gymnosperms. In all of these, except the fungi, he was able to get satisfactory crystals of cellulose, and has also obtained good results with a number of seeds, such as coffea,

strychnos, etc., by first treating oily seeds with ether. Cotton fibers and lignified tissues also yield crystals. Another interesting result is the obtaining of crystals from the test of an ascidian, Phallusia mamillata, this being confirmatory of the work of Winterstein who found that tunicine or animal cellulose gave dextrose as a derivative sugar just as vegetable cellulose does, and thus seeming to show that animal and vegetable cellulose are one and the same chemically.

From the results of his work on the plants, the following conclusions are drawn:

1. All that portion of the cell wall that is colored blue by chlorozinc-iodide, and that only, goes to make up the crystals.

2. The crystals are of pure cellulose.

3. All the cell walls contain cellulose, but while the internal layer consists almost entirely of it, the intermediate has only a small proportion, and the intercellular layer only a trace. These three layers were distinguished in sections treated by the method of Mangin, and those stained with methylene blue.

4. That the cellulose is found crystallized within the cell shows that its solution in Schweizer's fluid is not very diffusible, and also gives additional proof that it is derived from the inner layer of the cell-wall.

In the strictly chemical portion of his work, Gilson prepared convenient quantities of cellulose for working with by scraping to a pulp the stalk of cabbage or root of the beet, and proved by putting sections through the same treatment that he had a substance identical with the crystals found within the cells as described above. In fact he got from the pulp a mass of spherocrystals of the same kind formed in the cells.

By the method of Flechsig he finds that when all operations are carried on with extreme care, dextrose only (in the form of the silver salt of the derived saccharic acid) is obtained from cellulose, showing thus that cellulose is a definite chemical individual.

By using the method of Schultze he got from *Coffea arabica* a body corresponding to the mannosocellulose of Schultze. By precipitation from a solution of this with CO_2 he gets characteristic cellulose, and finds another carbohydrate is still left in solution. This second body gives not dextrose but mannose as a derived sugar. Mannosocellulose is then only a

mixture of true cellulose and another carbohydrate which Gilson proposes to call paramannane. The formula of the latter as he determined by several analyses is $(C_{12}H_{22}O_{11})_n$.

The paramannane thus obtained was in the form of a white powder of small spherocrystals, which dissolves in Schweizer's fluid as we have seen, and also in H_2SO_4, in the cold when concentrated, but when dilute only by heating, and then it turns to mannose. Gilson does not state whether paramannane turns blue on the addition of iodine reagents.

The results of his chemical work are: (1) Cellulose is a single chemical individual. (2) Mannosocellulose is a mixture of cellulose and paramannane. (3) The so-called reserve-cellulose is probably also a mixture of cellulose and some other carbohydrate or carbohydrates.

Additional investigation.

At the suggestion of Dr. J. P. Lotsy I repeated much of Gilson's work as given in the first part of his paper, in the laboratory of the Johns Hopkins University, at Baltimore.

I obtained a considerable number of the green plants mentioned by Gilson. From these in every case where good material was at hand the so-called crystals were readily obtained. Beta vulgaris gave very fine crystals after three hours or less in Schweizer's fluid, but a longer time was needed to dissolve all of the cellulose out of the cell wall.

Among others dahlia, lactuca, typha, ceratozamia, equisetum, and chara gave especially good results.

As to the diffusibility of the dissolved cellulose, I found that after keeping sections of the beet in Schweizer's fluid for twenty days, the crystals were as plentiful in the cells as at first.

The solution then resembles in diffusibility rather non-crystalline colloidal substances than crystalline ones.

This together with the appearance of the bodies themselves in some cases, led me to think that the things which Gilson called crystals were not really such. I therefore made several sets of preparations in which there were plenty of the bodies present, and examined them carefully under the polariscope. *In no case did they have any effect on polarized light, showing thus that they were not true crystals.*

I was gratified, though greatly surprised, to find later, that Gilson, after calling the bodies crystals all through his paper

and saying nothing of having tested them with polarized light, gave expression to the conclusion at which I had arrived, in the following sentence *in fine print at the end of the explanation of the plates:* "Les formes sous lesquelles se présentent le paramannane et la cellulose sont sans action sur la lumière polarisée; ce sont donc plutôt des cristallites que des cristaux."

As mentioned in the abstract of Gilson's paper, he got no *crystallites* (as we shall now call them) from mucor and agaricus. I tried both of these, together with saprolegnia and the fungal portions of several lichens, but although they gave the blue color with the iodine reagents, after treating with potash, they did not give any crystallites. The Schweizer's reagent did not dissolve out the blue coloring constituent of the tissues at all, the addition of chloriodide of zinc giving as strong a color after soaking for two weeks in Schweizer's reagent as at first, the color always being evenly diffused through the tissue.

In regard to vegetable tissues then, my work has been entirely confirmatory of Gilson's.

As mentioned above, the only animal tissue with which Gilson worked was the test of phallusia, and here he states that he obtained crystallites similar to those in vegetable cells.

I also worked on several ascidians, beginning with salpa, but although the test gave a strong blue color with chlorozinc iodide both before and after treatment with Schweizer's fluid, I was never able to get any of the crystallites to form, and also, as in the fungi mentioned above, none of the blue coloring substance dissolved out by prolonged treatment with Schweizer's reagent. There were in some cases bodies which I at first mistook for the crystallites, but on more careful examination it was found that their seeming blue color was due to the color of the surrounding tissue, and moreover they proved to be true crystals when tested with the polariscope.

I decided to try Gilson's method in testing for cellulose on other animal tissues and found many suggestions as to what to use in a paper by H. Ambronn, on "Cellulose Reaction bei Arthropoden and Mollusken," in Mittheil. aus der Zool. Sta. zu Neapel **9**: 475.

Ambronn found that after treatment with alcoholic potash he could get a distinct blue with iodine reagents in several widely separated arthropods, such as eupagurus, squilla, sap-

pharina, calotermes and julus. Among the molluscs he obtained the cellulose reaction in sepia, the pen of loligo, the radula of helix and the opercula of several species of natica.

The skeletons of rhizopods among the protozoans, the perisarc of hydroids among the coelenterates, the tubes of annelids such as onuphis and polyodontes and also the skeletons of bryozoans among Vermes, gave no indication of the presence of cellulose.

Without attempting to verify all of Ambronn's results, I worked on a number of animal tissues, first trying the iodine test for cellulose on various parts of different arthropods and mollusks and then with such tissues as the skeleton of horny sponge, integument of the starfish and nereis, and vertebrate dermal tissues such as hair, skin, and nails. In the mollusks the pen of loligo and radula of paludina, and among the arthropods the integument of the abdomen of eupagurus, the stalk of lepas, gills of limulus, and tests of ascidians such as salpa, molgula and amaroecium, all gave results confirmatory of those of Ambronn. As was to be expected from the lack of mention of such a thing in the literature, the vertebrate tissues gave no indication at all of cellulose.

I next applied Gilson's test for the presence of cellulose to some of the above which gave the strongest color with chlorozinc iodide, to see if I could obtain the blue-staining substance in the form of crystallites. The pen of loligo gave an intense violet with chlorozinc iodide but keeping for fifteen or twenty days in Schweizer's fluid did not decrease the intensity of coloration when the sections were stained with chlorozinc iodide afterward, nor could any crystallites be obtained by precipitating with ammonia.

In the same way the tissues of eupagurus, molgula and paludina were tried and all gave results like that in the case of loligo, the blue-coloring substance not seeming to be dissolved out but remaining as at first uniformly diffused through the tissues.

The occurrence of the blue coloration in so many of the truly chitinous animal tissues suggested the idea that chitin or some derivative of it might give the blue color. The method of preparation of glycosamine by Ledderhose resembles in several steps that of Ambronn for the demonstration of cellulose in animal tissues. I therefore (although a blue staining with the iodine reagents had not been mentioned as one

of its properties) made a preparation of glycosamine by the method of Ledderhose, and tried it with chlorozinc iodide to see whether it gave the blue color, and found that it did not.

This subtance is dextro-rotatory and reduces Fehling's solution as readily as dextrose, and these facts may account for the supposed derivation of true dextrose from chitinous tissues by the older observers, and hence we have only the work of Winterstein on tunicine to prove the existence of true cellulose in animal tissues.

In conclusion then, I am inclined to think that Gilson's test for cellulose is a much more satisfactory one than the ordinary chlorozinc iodide test, and should therefore replace the old method in the demonstration of cellulose in vegetable tissues in the laboratory. Its use in my hands seems to prove that the blue staining substance present in tunicates, arthropods and certain mollusks is not identical with vegetable cellulose chemically.

We must, however, consider the animal substance under discussion as possibly quite similar to, perhaps only a slight modification of, true cellulose. For as we have seen above, the substance of the supporting tissue of the fungi, which as we know have arisen from plants that in all probability possessed true cellulose, are still as refractory as animal tissues when treated with Schweizer's solvent.

Johns Hopkins University, Baltimore, Md.

Noteworthy anatomical and physiological researches.

The periodic reduction of chromosomes in living organisms.

Under this title Professor Eduard Strasburger communicated a very important paper to section D of the British Association last August. A translation of the paper appears in the *Annals of Botany* for September, and so many of our previous views are affected by it that it deserves a somewhat full mention.

Calling attention in the outset to the fact that sexual differentiation in plants was preceded by asexuality, the author shows that when this differentiation was attained it finally led to the production of a new generation set apart to spore production, and that in alternation of generations the sporophyte is the newer generation, having arisen from the gametophyte. In the production of this sporophyte it has been noted that the two gametes concerned have nuclei containing half the number of chromosomes characteristic of the nuclei of the resulting sporophyte, and this reduction has been regarded as a special preparation for the sexual act. Upon this hypothesis there have been constructed various theories with regard to the reduction and to the significance of the sexual act. Strasburger and other observers find, however, that this reduction in the number of chromosomes in the generative nuclei of angiosperms is determined in the mother-cells of the pollen and embryo-sac, and not during the maturation of the sexual cells. The physiological utility of this reduction is evident in the prevention of the indefinite increase of chromosomes with every succeeding generation and in securing the equal representation of each parent. The morphological cause, however, is phylogenetic, for it is simply a return to the original generation which had attained sexual differentiation, and which in consequence had developed as offspring sporophytes containing nuclei with double the number of chromosomes. This reduction, therefore, is not the outcome of a gradually evolved process of reduction, but is the sudden reappearance of the primitive number of chromosomes as it existed in the nuclei of the generation in which sexual diffe:-

entiation first took place. This reduced number which is determined in the spore mother-cells in angiosperms persists in all subsequent divisions to the formation of the generative nuclei, involving usually four divisions in the history of the male nucleus, and five in the case of the female, although in the latter case the divisions may be three, four, five or more. It is evident that the attempt to establish homologies between the successive divisions preceding the formation of the two generative nuclei is futile; and it is equally worthless to claim on physiological grounds the necessity for a certain definite number of nuclear divisions that the two nuclei may be brought to the same bulk. The reduction in the number of chromosomes, therefore, is not to be regarded as a preparation for the sexual act, but it marks the beginning of a new generation which comes into existence with the primitive number of chromosomes, of which generation the spore mother-cell is the initial cell.

Professor Strasburger traces backwards the phylogenetic course of the reduced ontogeny exhibited by the primitive sex-differentiating generation in angiosperms. In the developing endosperm of gymnosperms the reduced number of chromosomes is found long before the development of archegonia has begun.

This further emphasizes the fact that the number of successive nuclear divisions which precede the generative nucleus is very variable and holds no relation in the parallel male and female generations. In pteridophytes and bryophytes the number of chromosomes is hard to determine on account of the small nuclei of the latter and the great number of chromosomes of the former. In some ferns, however, as Osmunda regalis, the number of chromosomes is as small as in phanerogams, and in this case the reduction appearing in the nucleus of the spore mother-cell persists throughout the prothallium, and is half the number found in the sporophyte. Among bryophytes the counting of chromosomes has been accomplished in a liverwort, which showed four chromosomes in gametophyte nuclei and eight in sporophyte nuclei, the number four appearing first in the spore mother-cell. No countings of the chromosomes in algæ and fungi have been made, due partly to the difficulty of the operation and partly to the lack of appreciation of its importance. That the number of chromosomes in these lower cryptogams is definite Strasburger believes from the few preparations he has examined.

While constancy in the number of chromosomes in the generative nuclei is doubtless of great importance, there is no such constancy in the nuclei of the somatic cells in either generation. Variations in the number are often observed in cells that are no longer embryonic, and especially in those definitively excluded from the sphere of reproduction (as the lower nucleus of the embryo-sac from which the antipodal cells are derived, and also the definitive nucleus which originates the endosperm). In the prothallial nuclei of Pinus sylvestris it has been observed that the reduced number is adhered to until the development of archegonia, and then it may be departed from, sometimes even doubling in the large nuclei of the wall-cells of the archegonia.

In the case of apogamy among ferns it seems probable that the number is doubled on the development of the growing points of the sporophyte. In the case of apospory it seems probable that there is a corresponding reduction, or else the resulting prothallia must contain twice as many chromosomes as normally developed prothallia.

The continuity of the chromosomes from generation to generation is maintained, and while they may lose their morphological individuality in the resting nucleus, their physiological individuality is retained. The reduction in the number at the initiation of the sexual generation is said to be due to the fusion of two chromosomatic individuals into one, and this is preceded by the ordinary nuclear division. There is no such thing among plants as nuclear divisions resulting in the reduction of the number of chromosomes by one-half.

It is also shown that there is no such thing as hereditarily unequal divisions in karyokinesis. The author believes thoroughly in epigenesis, and that cell-nuclei, wherever in the body they may be, are and remain endowed with all the characteristics of the species and are stimulated to activity in definite directions by prevalent conditions. He approves of Weismann's term "id," as it represents something supported by direct observation. He would recognize as ids the serially arranged discoid segments of the chromosomes. These ids are repetitions of each other, and in the sexual act the chromosomes of the parents do not lose their independence, but show various results in various parts dependent upon the interaction of the chromosomes giving rise to phenomena of interference. In this way the various resemblances of hybrids

and also atavistic phenomena are to be explained, the latter showing that the ids whose action is neutralized are not destroyed.

While one-half reduction takes place in bryophytes, pteridophytes and phanerogams in spore mother-cells, in the lower cryptogams, where the oospore does not give rise to a definite sporophyte, the reduction probably takes place on the germination of the oospore. This reduction is the return of the most highly organized plants, at the close of their life cycle, to the unicellular condition, the repetition of phylogeny in ontogeny.

In carefully comparing the generative processes of animals and plants it becomes evident that there is nothing in plants which corresponds to the polar bodies of animals, and that such reference of the ventral canal-cells of archegoniates is without foundation.

The spore mother-cell, therefore, is to be regarded as the first term of the new generation. The center of gravity of the developmental processes which take place in sporangia does not lie in the cells styled the "archesporium," which still belongs to the asexual generation, but in the spore mother-cells. It is of little importance whether there be a well-defined archesporium or not, as it is merely the meristematic tissue from which the spore mother-cells are derived, so that its differentiation cannot be of any special significance.— J. M. C.

Anatomy of the genus Carex.

It seems very natural that a genus so large as Carex, estimated to contain about 800 species, has caused considerable trouble to the systematists in regard to the most natural arrangement of the numerous species. The modern discrimination of species by means of anatomy is far from always to be applied as a support for the systematic position of species in natural groups; this is only too manifest, when we compare the results gained by recent investigations. And with the genus Carex, we are far from through yet, though the present time seems to throw some light upon the conception of the true relationship among the species. Valuable assistance has been rendered to students of this genus by the authors who have made a special study of the anatomy of a number of species. Bordet[1] and Mazel[2] have given several anatomi-

[1] Recherches anatomiques sur le genre Carex. Revue générale de Botanique, **3**: 57. 1891.

[2] Etudes d'anatomie comparée sur les organes de végétation dans le genre Carex. 1—213. *pl.* 7. 1891. [Thèse. Genève.]

cal details of many species of this genus, and we have now received a still more comprehensive treatise by Lemcke,[3] wherein an attempt has been made to arrange the species in natural groups by means of their anatomical characters.

The first chapter of this interesting and important work contains a review of the literature upon this subject.

The author has studied especially the internal structure of the rhizome, but several points of interest have also been given in regard to the anatomy of the aerial stem and the leaf. Boeckeler's system[4] has been followed as a basis in the present investigation.

The material examined includes representatives from Europe and North America, so that the paper becomes very helpful to similar studies in this country.

Very little has been added to the results given by earlier authors, and the most essential points seem to have been already discovered. The important studies of Klinge, Laux, Mazel and Schwendener seem to contain all of the salient features in the structure of this genus, but the present paper embodies the first attempt to arrange the species anatomically.

It would be impossible to give a satisfactory review of all the anatomical peculiarities in condensed form, and we therefore restrict ourselves to a brief comparison of some of the results.

The author has found the anatomical structure of the rhizome sufficient for the discrimination of the various groups, and in many instances the species are readily distinguished. The system suggested by Christ,[5] seems to be the most natural, although the author admits that he was not able to find in anatomical characters sufficient foundation for several of the sections in this system.

The arrangement of the species in Heterostachyæ, Homostachyæ, Cephalophoræ and Monostachyæ in the system of Christ is widely different from that which has been proposed by Bailey.[6] For instance: Christ refers CC. obtusata, pyre-

[3] A. LEMCKE: Beiträge zur Kenntniss der Gattung Carex. 1–130. 1892. [Inaug. Dissert. Königsberg in Pr.]

[4] Die Cyperaceen des königlichen Herbariums in Berlin. Linnæa N. S. **5–7**:—1875–77.)

[5] Nouveau catalogue des *Carex* d' Europe. Comptes-rendus d. séances de la Société Roy. de Botanique de Belgique **24**:—. 1885.

[6] A preliminary synopsis of North American *Carices*. Proceed. of American Academy of Arts and Sc. **22**:—. —.

naica, microglochin, gynocrates, and dioica to a section "Psyllophoræ" and CC. capitata and scirpoidea to "Capitatæ," both sections of the group Monostachyæ. These species are widely separated from each other in the system of Bailey, so far even that C. microglochin has been enumerated as no. 1 under the section "Physocarpæ," C. scirpoidea as no. 184 under Sphaeridiophoræ, C. pyrenaica as no. 211 under Lamprochlaenæ, C. obtusata as no. 215 in the same section, while the remaining C. capitata, C. gynocrates, and C. dioica as nos. 255, 258, and 259 under the section Acroarrhenæ.

Lemcke shows now that these species are most naturally combined in one single section, Psyllophoræ, of the Monostachyæ. C. pyrenaica and C. scirpoidea are closely related to each other by having subepidermal groups of stereome in their rhizomes, which the others have not. C. pyrenaica has thick walled epidermis cells, while these are papillose-prominent in C. scirpoidea. C. Fraseri is closely related to these two species.

Tangential aeriferous lacunes are present in the bark of C. capitata and C. gynocrates, while these are radial in C. dioica and microglochin. C. dioica has a closed sheath of stereome around the mestome bundles, which is not observed in C. microglochin. It is to be seen from these investigations that we meet with great discrepancies in regard to the anatomical structure if we compare the species as they have been arranged by Bailey. The large number of well differentiated species in proportion to the relatively few morphological characters makes it exceedingly difficult to reach even an approximation to a truly natural classification, but we should not be surprised if extended studies justify the system given by Drejer in his excellent treatise, Symbolæ Caricologicæ.—THEO. HOLM.

BRIEFER ARTICLES.

Synchytrium on Geranium Carolinianum.—(With plate IV.)—On the fourth of February of last year, some distorted leaves were gathered from *Geranium Carolinianum* L. growing in a low place in the botanical garden at Baton Rouge, La., and examination showed the distortions to be due to a *Synchytrium*. On the margins of some of the lobes, and extending in along the veins, on the lower surface, were purple-red swellings. The hypertrophy of the diseased parts was in many places so great as to cause a cupping of the upper surface. The older swollen portions were brown, and had a sticky feel, and the centers of the confluent pustules composing them were depressed, giving the appearance of small cups placed side by side (fig. 1). The pustules were almost entirely confined to the blades of the leaves.

On the date mentioned, only one Geranium was found affected with Synchytrium but in the same locality, three weeks later, the disease had spread to a number of individuals, and the red swellings were numerous on both petioles and blades. On leaves recently attacked, single red pustules were scattered here and there over the lower surface, occasionally on the upper, but on those longest subjected to the action of the fungus, the pustules had multiplied and become confluent, giving the appearance observed on the leaves first collected.

A section through one of these pustules, in a direction perpendicular to the surface of the leaf, shows an elongated, usually pear-shaped cavity (figs. 2 and 3), filled with a coarsely granular, reddish brown substance whose particles cohere into a sort of network of varying openness of texture. Toward the lower part of the cavity, the granular material becomes finer and more compact (fig. 3), and imbedded in it is either a sorus or a resting-spore; in the material examined, sori were far more numerous than resting-spores.

The resting-spores have a dark brown, laminated, outer covering, and a delicate, colorless, inner coat (figs. 4 and 5), enclosing yellowish granular contents, bearing occasional oil globules. These spores vary greatly in size, ranging from 35μ to 150μ in diameter. The smaller ones often lack the surrounding granular deposit that seems always to attend the larger resting-spores and sori, and as many as four are frequently found in the same cavity (fig. 5). The outer coat of the small spores also appears more compact and more close fitting than that of the large ones (figs. 5 and 4). The large spores are usually spherical, but not infrequently ellipsoidal, and in very rare cases are crescent

shaped. These marked differences between the large and small resting-spores would indicate the possibility that the larger ones are sori in process of formation, and whose contents have not yet broken up into sporangia.

The sori are usually spherical, occasionally ellipsoidal, and range from 75μ to 125μ in diameter. The outer covering of the sori is essentially the same as that of the large resting-spores; the inner sack is thin and colorless, and encloses numerous sporangia (fig. 6). The sporangia are irregularly polyhedral, and have delicate, colorless walls filled with finely granular, reddish yellow contents. They vary from 20μ to 37μ in diameter (fig. 7).

The cells of the tissue surrounding the spore-bearing cavities are usually filled with a red sap that gives to the pustules their purple-red color. The hypertrophy seems to be mainly due to multiplication rather than enlargement of the cells; these are noticeably increased in size only in that part of the pustule immediately surrounding the upper part of the cavity (fig. 3). The enlarged cells have much thinner walls than do those of the normal size, and as the pustule ages, these thin walls break away and leave a large opening through the epidermis into the cavity below. This exposure of the reddish brown substance within probably gives to the older diseased parts the sticky feel mentioned above.

The only representative of the Geranium family given in Farlow and Seymour's Provisional Host-Index as a host for Synchytrium, is *Erodium cicutarium* L'Her. The naked-eye appearance of the Synchytrium on Geranium is very similar to that of *S. papillatum* Farl., on Erodium, but the sori average considerably smaller, and the resting-spores have a much greater range of size. Schroeter mentions *S. aureum* Schroeter, as occurring on *Oxalis stricta* L., in Silesia, but the Synchytrium in question has not the characteristics of S. aureum. Neither Saccardo's Sylloge Fungorum, Schroeter's Kryptogamen-Flora von Schlesien, nor Rabenhorst's Kryptogamen-Flora von Deutschland, Œsterreich und der Schweiz gives Geranium as a host for Synchytrium. It is possible that the Synchytrium on Geranium Carolinianum is a new species, and if so, I would propose the name Synchytrium Geranii.

NOTE.—Since writing the above, I find in the herbarium of the University of Michigan a specimen labeled *Synchytrium Geranii*, E. & G., College Station, Texas. In reply to my inquiry in regard to it, Mr. Ellis writes me that the fungus was first named *S. Geranii* E. & G., and the name was afterwards changed to *S. Fairchildii* E. & G., but neither was ever published.—IDA CLENDENIN, *Baton Rouge, La.*

EXPLANATION OF PLATE IV.—Fig. 1. Lobe of leaf of *Geranium Carolinianum* L., attacked by *Synchytrium*. Slightly magnified.—Fig. 2. Section through confluent pustules on vein of leaf. Section does not pass exactly through center of pustules; × 60.—Fig. 3. Section through center of pustules; granular mass almost fills the cavity, and resting-spore lies imbedded in lower part; × 150.—Fig. 4. A large resting-spore; × 315.—Fig. 5. Section through cavity containing several resting-spores; × 315.—Fig. 6. Sorus, with portion of reddish brown covering adhering to one side; × 315.—Fig. 7. Sporangium of same; × 315.

Formulæ for life histories.—I have found certain formulæ very useful in presenting general life histories to my classes. I do not know whether others are using them or not. If not, it might be well to suggest them, for they are very helpful in fixing the broad facts.

G = gametophyte; o = gamete; O = spore (sexual or asexual); S = sporophyte.

Isospory = G—o—O—S—O—G.

Heterospory = G—o, G—o, O—S, o—G., o—G.

Apogamy = G—S, o—G., o—G. = vegetative apogamy, with heterospory.

G—o, G—o, S, o—G., o—G. = parthenogenesis, with heterospory.

Apospory = G—o—O—S—G.

and so on *ad infinitum*.

This is useful not only in presentation but in quizzing. For instance, ask a student to indicate in this way the life history of an angiosperm, a fern, a mildew, anything. It seems to make it very real to him.—JOHN M. COULTER, *Lake Forest, Ills.*

Uredineæ Americanæ Exsiccatæ.—It is almost a year since the author published his prospectus of the above series of exsiccatæ, and only one fascicle has been issued. Two facts, if known at that time, would have precluded any thought of publication of this series; the one, that of change of employment of the author which would make it utterly impossible to give sufficient time to the work; the other, that preparations for a similar series by other parties had been begun a long time before. These facts will therefore serve also to explain why no other fascicles have appeared. It is thought best now to announce definitely that the series will be permanently discontinued.

Such announcement has been delayed because of the hope that it would yet be possible to continue the series, upon which so much labor had already been bestowed. The encouragement given to the work by various botanists in America and Europe is very much appreciated.

There is no doubt whatever of the desirability of such a series of Uredineæ in this country, and botanists are to be congratulated that we are still to have one, and especially under no less reliable management than that of Dr. Arthur and Mr. Holway.—M. A. CARLETON, *U. S. Dept. Agric., Washington, D. C.*

Isoetes saccharata.—In August, 1893, the writer collected specimens in Back creek, a tributary of Elk river, Maryland, which seemed to be *Isoetes saccharata* Engelm.," but the material was lost, with the exception of one poor specimen, and identification was not entirely conclusive.

In August of last year, an abundance of fresh specimens was procured at the same place, and a further quantity in Piney creek cave, Elk river. There is no doubt now as to the species. This station is in the neighborhood of eighty miles north of Mr. Canby's original station on Wicomico and Nanticoke rivers. Some exploring was done by me this year along the shores of Sassafras and of Still pond, intervening between Elk and Wicomico, without finding any of the plant. But it is probable that the distribution will be found, eventually, to be continuous along the eastern shore of the Chesapeake, in a belt cutting the numerous rivers a few miles back from the bay, and extending at least from Elk to Nanticoke rivers.—T. CHALKLEY PALMER, *Media, Pa.*

EDITORIAL.

It is probably true that never in the history of botany has the development of our knowledge advanced at such a rapid rate as now. Investigations have multiplied so enormously and technique is becoming daily so much more refined that facts are coming to light too rapidly to classify. This state of affairs has brought upon us a period of hasty and broad generalization that is to be deplored. The only useful function of generalization is to suggest lines of further inquiry, and broad generalization is never so much out of place as when facts are coming in rapidly. It seems impossible now to write a book upon any general subject in botany which is not antiquated in some parts before it reaches our shelves. Especially is this true in reference to generalizations concerning phylogeny. Treub's discovery of the so-called chalazal entrance of the pollen-tube in Casuarina no sooner lays the foundation of a reconstructed scheme of classification, current long enough to be followed in other publications, than two other observers announce the same condition of things in *Amentiferæ*. The immense importance of the development and form of the archesporium is no sooner embalmed in books that have appeared and have been announced than Strasburger transfers the "developmental center of gravity" to the mother-cells, and opens up a vast field of new inquiry in the numerical relations of chromosomes. The boundary line between gametophyte and sporophyte is no sooner well established in our texts and minds and generalizations, than it is shifted. Examples might be multiplied on every hand, and they serve to emphasize the point we intend to make, namely, that only such generalization as suggests further investigation is to be thought of at such a time as this, and that broad generalizations leading to extensive reconstruction of views are worse than useless. The record of facts, the stringing of these facts upon some consistent thread of theory, are now and always must be necessary, but the constant reconstruction of phylogenies is surely as unprofitable as it may be misleading.

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It is in order for the resuscitators of *Science* (which we are glad to greet again), to rise and explain to the botanists whose support they seek, why phanerogamic taxonomy only should be represented in the editorial committee while five specialists are considered necessary for proper presentation of zoological matters.

CURRENT LITERATURE.

An introduction to structural botany.[1]

This book contains a description of the morphology of the wall-flower, white lily, and spruce fir as types of dicotyledons, monocotyledons, and gymnosperms, respectively. In writing it Dr. Scott has intended to make it a first guide to the study of the structure of the seed plants, and has sought to put before beginners in the study of botany information which is correct as far as it goes. The book is of course to be used only in connection with laboratory study of the plants themselves. The author has succeeded admirably in executing his design, and there is little to be criticised unfavorably. One can hardly help the feeling that for beginners he sometimes goes too far into details, but it is not easy to say what should be passed over.

Aside from a few unfortunate phrases, such as "male flower," what we should consider a blemish in the book arises from the order of treatment. The author begins with the seed plants. Had he made the proposed second volume on cryptogams the first, we think he would have done wisely. But there will always be difference of opinion on this point, and Professor Scott doubtless considered carefully the objections and advantages in both modes of treatment.

By reason of the order selected, however, he meets insuperable difficulties in the presentation of a really modern view of the flower and the reproductive organs connected with it. There is no hint at the nature of pollen grains and the embryo sac, or of the cells formed in them. In discussing the gymnosperms he is obliged to refer to the resemblance of the sexual organs of the female gametophyte to corresponding organs in certain cryptogams. If it be replied that these are matters too recondite for an elementary book on morphology, it may be answered that they would be matters of course had they been approached from the other direction. Naturally one can not drive the butt end of the wedge into a log.

An excellent chapter on nutrition is introduced after the description of the two angiosperms; from which we fear the ordinary student (whose capacity for misunderstanding is almost limitless) might infer that the matter did not apply to the gymnosperms.

We trust that Dr. Scott will find this volume meeting with such success that he will soon prepare the companion volume on cryptogams.

[1] SCOTT, D. H.: An introduction to structural botany (flowering plants). 12mo. pp. xii + 288. figs. 113. London: A. & C. Black. [New York: Macmillan & Co. $1.00.]

A "practical flora."[1]

What is it? Barring the need of a distinctive name and one that would aid in selling the book any one would be puzzled, we imagine, to say why it should bear such a title. True, Mr. Willis, the compiler (for he is nothing else), says in the preface that his design is "to show the practical aspects of the vegetable world," and asserts that "there has been a long-felt want for a work of such practical character, and this book has been prepared to meet the demand." But his book is neither a *flora* nor *practical*, so far as we can judge. It is a compilation of descriptions of flowering plants selected from all countries under the sun, including a large number of native plants. On what principle the "careful selection" is based does not appear except in the preface. The exotics described are generally plants of economic importance, but many other species of *equal* economic importance are not described.

Indeed the writer seems to have selected his plants to fit his pages. At the beginning, when the pages were all before him, we find among the Ranuculaceæ forty-three species described, including such unimportant ones as Ranunculus rhomboideus and Anemone parviflora; of Viola eighteen species, including V. Selkirkii; while as space began to diminish, the Compositæ are cut off with six and Liliaceæ with nine!

How this book could be "the outgrowth of a successful class-room experience" we cannot understand. Does Mr. Willis have his students "analyze" Cinchona calisaya, or Diospyros ebeneum, or Areca catechu, or any of the multitude of other plants that they never saw, and never will see, in this country? We could understand an encyclopedia of economic plants; but this book, with its mixture of native and exotic, valuable and useless plants, with its "keys" and descriptions, its scrappy accounts of history and use, is quite beyond our understanding.

We cannot afford space for quotation, except of a few definitions which introduce the book, that our readers may be enrolled among "the people we have smiled with."

"*Structural Botany* has for its object the investigation of the structure, mode of growth, and functions of the cells and vessels that make up the plant. *Organography* is a division of this department that has special reference to the organs. *Morphology* is properly a division of Structural Botany and notes the changes that take place in the cells and tissues of plants. *Physiological Botany* takes into consideration the vital action in the reception, preparation, and disposition of the nourishment necessary to keep up the growth of the plant and to

[1] WILLIS, O. R.: A practical flora for schools and colleges. 8vo. pp. xvi + 349. New York: American Book Co. 1894.

enable it to perform the offices of flowering and fruiting. . . . To the above may be added the *Art* or *Practice* of Botany, which consists in applying the principles investigated under the above heads to determining the class, order, etc., of an individual plant."

Comment is unnecessary. The American Book Co.'s "reader" must have been on a vacation when they accepted this book!

Bacteriology and the dairy.

Dairy products constitute a valuable source of wealth in the United States, and several colleges have already established dairy schools. Wisconsin is not only in the front rank of states in the value of its milk products, but was the first to establish a thoroughly equipped dairy school. Shortly after that was done Dr. Russell was put in charge of the bacteriological work of the experiment station and the dairy school, and much important work is now in progress. The experiment station now conducts a creamery throughout the year, which gives opportunity for bacteriological and other experiments on a commercial scale. A science so important to the dairymen of course demands a place in the instruction of the dairy school. Finding no suitable small manual of bacteriology in its relation to the dairy, Dr. Russell set himself to write one.[1] It is divided into three parts, the first giving a summary account of the bacteria in general, while parts two and three are concerned with bacteria in their relation to milk, and bacteria in their relation to milk products. The author's endeavor has been to present the important facts in regard to the bacteria in a compact and simple way, and then to apply these principles to the practice in the dairy, creamery, and cheese factory. Since the book is intended mainly for students and dairymen the author has written in language as free from technical terms as possible, though he has not sacrificed clearness for the sake of doing this. He has also avoided overburdening his text with references to literature, though authority for many facts is cited.

We hope that the conciseness, simplicity, and accuracy of this little manual, as well as its commercial bearing, will insure it a wide sale, and that the first edition will soon be exhausted. This edition has been purposely kept small so that the book may be kept up to date in the rapidly advancing science of which it treats.

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[1] Russell, H. L.: Outlines of dairy bacteriology. Small 8vo. pp. viii + 186. Madison, Wis.; published by the author. $1.00.

An outdoor book.

The list of those who love to wander afield and drink in the beauties of unspoiled Nature under all skies is a long one. A few have seen, and have tried by telling their visions to awaken the love of others. Thoreau, Flagg, Burroughs, Abbott, Gibson, are names well known in this form of literary effort; and there are a host of others less familiar, perhaps, but scarcely less interesting. There lies before us a book[1] by Mr. Joseph Jackson, of Worcester, Mass., entitled, "Through Glade and Mead," which brings visions of the same fields, meadows, and woodlands, seen this time through the eyes of a botanist. Mr. Jackson writes of the plants and birds with the pen of a lover and even the "closet botanists," as they are reproachfully called, reading his lines, will want to go back to their freer days and prowl through glade and mead once more.

As appendix A appears the second edition of the Flora of Worcester county, a catalogue of the phaenogamous and vascular cryptogamous plants containing 1,098 species and varieties, of which fifty-five are cryptogams. Appendix B is a list of the trees, shrubs, and evergreen plants growing in the same region.

The book is most elegantly printed and is illustrated by a series of half-tones from photographs by Mr. Lyford. An *edition de luxe*, thirty-five signed copies illustrated by fourteen platinotypes, has also been issued, and the ordinary edition is limited to 500.

Minor Notices.

While books of this nature hardly come within the scope of this journal, Mr. Foster-Melliar has given us such a charming volume in his "book of the rose"[2] that it deserves mention. The writer is a successful enthusiast in the cultivation of roses, and gives the benefit of his long experience in a clear and full way that leaves little to be desired. A history and classification of roses is followed by a consideration of soils, planting, manures, pruning, stocks, propagation, etc. An interesting chapter deals with "pests," both insects and plant parasites, and a monthly calendar of necessary operations closes the volume, which is also completely indexed. The happy style of treatment, and the clear presentation of the needful operations would tempt almost any one to become a "rosarian."

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[1] JACKSON, JOSEPH: Through glade and mead; a contribution to local natural history. 8vo. pp. xiv + 332, illust. Worcester, Mass.: Putnam, Davis & Co. 1894.

[2] FOSTER-MELLIAR, REV. A.: The book of the rose. 8vo. pp. 336. pl. 29. London and New York: Macmillan & Co. 1894. $2.75.

OPEN LETTERS.

The term phytobiology.

The ever increasing attention given to the different phases of adaptation is making evident the need for an agreement upon some comprehensive term to express its study. At present the word *biology* is generally employed for the purpose in English, and there is perhaps a tendency to limit its application to this use; but the fact that the word has been understood in so many meanings, or at all events, shades of meaning, makes it by itself an unsatisfactory term, especially for botanists who must fain explain that it is plant biology they mean. The words *œkology* and *bionomics*, coined for this very purpose, are awkward, little used, and except to the learned do not explain their own etymology. A single word in English, answering to the German *Pflanzenbiologie*, does not appear to be in use, and I have therefore ventured to employ in publication (reference in BOT. GAZ. 19: 345. 1894) the equivalent and self-explanatory word *phytobiology*. I wish to ask whether there is any objection to this term, etymological, botanical or practical, and if so, what better one can be suggested; and also whether it has yet been published elsewhere in English.—W. F. GANONG, *Smith College, Northampton, Mass.*

[We may call Prof. Ganong's attention to the action of the Madison Botanical Congress (Proceedings p. 36) upon this point in recommending the use of the term *ecology* to designate the subject matter covered by the German Pflanzenbiologie. It is quite true that ecology has as yet been little used, but it is rather because the subject matter has been little studied in this country than because the word is awkward or unintelligible. Moreover the objection that it is "little used" lies equally against "phytobiology" and must lie at first against any new word. Ecology is already in the dictionaries, though (in the Century at least) under Œ. The committee of the Congress which considered this subject thought it better to take a word already coined than to construct a new one. The modification in spelling suggested is in harmony with spelling reform and with the common word *economy*, of similar roots.

The word phytobiology seems to us open to very serious objection because of its etymology. It ought by construction to be the equivalent of the word botany, i. e., that division of biology which is engaged with plants. Witness, similarly, phytopathology, phytochemistry, phytogeography. Phytobiology, moreover, is already in the language under the meaning just stated, for it is defined in the Century dictionary and a citation of its use in this sense given.—EDS.]

NOTES AND NEWS.

MR. R. SCHLECHTER publishes in *Journal of Botany* (Dec.) his second decade of new species of *Asclepiadaceæ* from South Africa.

MR. GEORGE HANSEN of the Agricultural Experiment Station, Jackson, California, announces the distribution of sets of the flora of Amador, Calaveras and Alpine counties.

ERYTHEA (Dec.) contains several new western species, by Greene; and some corrections in nomenclature by the same author, notably the replacement of *Hesperochiron* Watson by *Capnorea* Raf.

BULLETIN L'HERB. BOISS. (Nov.) contains a new *Riccia* (with two plates) from Lusitania, by Levier; a new *Eragrostis* from France, by Daveau, making four species belonging to the flora; and a monograph of the Swiss *Massarieæ*, by Jaczewski.

THE USUAL interesting report of the Department of Botany of the British Museum for 1893 appears in *Journal of Botany* (Dec.) A very large series of collections is indicated as having been received, but there is no summary to indicate the total additions.

A GARDEN SCHOLARSHIP in the Missouri Botanical Garden is to be awarded by the Director before the first of April next. Applications must be in his hands before March 1st. Information as to conditions of the award may be obtained by addressing the Director, Dr. Wm. Trelease, St. Louis, Mo.

THE TENTH ANNUAL meeting of the Indiana Academy of Science during the last week of December developed the usual large number of botanical papers. Botanical work in Indiana is rapidly increasing both in interest and amount. Of the fifty-two biological papers presented thirty were botanical.

PROFESSOR EDWARD L. GREENE has been appointed Professor of Botany in the Catholic University at Washington. This transfer from the Pacific to the Atlantic coast is a notable one botanically. We wish him pleasure in the more frequent contact with botanical friends and workers that this will bring him.

IN *New Education* Professor Stanley Coulter is giving a series of papers on "Graded instruction in botany below the high school." The suggestions made seem to be wise from the standpoint both of science and pedagogy, a combination which is too rare in these days of the introduction of elementary science training.

PROFESSOR F. A. FLUECKIGER, formerly of the University of Strassburg, died at his old home in Bern, Switzerland, on December 11th, at the age of sixty-six years. He had been in somewhat poor health for some time, but his death was not anticipated. Many botanists and other scientific men had the pleasure of greeting Prof. Flückiger at the Brooklyn meeting of the A. A. A. S. last summer.

MR. J. N. ROSE desires both living and herbarium specimens of Tradescantia and Commelina from all parts of the United States. He is especially anxious for roots and flowering specimens of the various forms of T. Virginiana. He will name and return specimens when desired. Franks for the sending of specimens will be furnished on application.

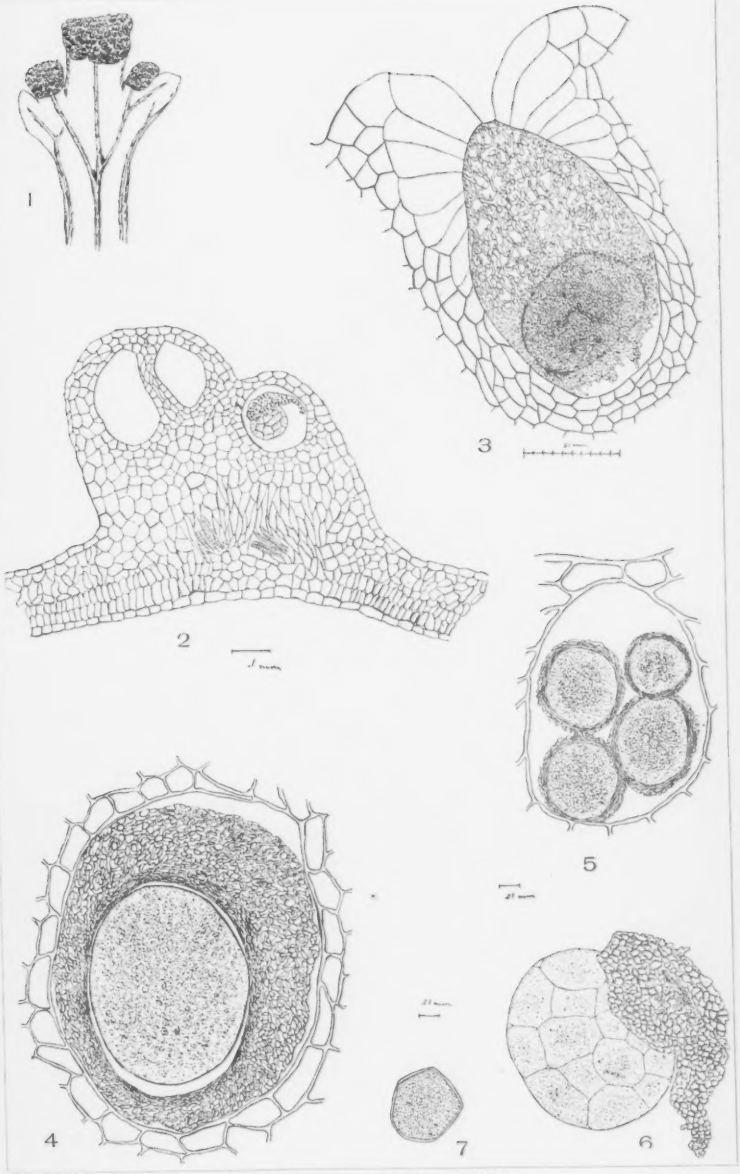
GARDEN AND FOREST continues to publish fine illustrations of our interesting native plants. Among the late ones we note (Dec. 12th) *Quercus Garryana* of the Pacific slope, and (Dec. 19th) the "Muskeag Spruce," characteristic of the forest lakes of Minnesota. In the latter number Mr. Charles H. Coe gives an interesting illustrated account of the so-called "Florida sea beans," which he says belong to four genera, only one of which grows in this country.

THE PUBLICATION of *Science* has been resumed for the third time, by the recent publication of number 1 of volume I of a new series, under the direction of a committee of eighteen, made up of representatives from different editorial sciences in rather unequal fashion. The department of botany is in charge of Dr. N. L. Britton. The list of names given is a very strong one, and if the financial backing is as strong as the scientific the journal should be very successful. We wish it a long and prosperous life.

FOLLOWING M. Vesque's recent monograph of *Guttiferæ* Mr. Edmund G. Baker in *Journal of Botany* (Dec.) presents notes of the group obtained from a revision of the material in the British Museum. The chief purpose of the notes is to call attention to the fact that M. Vesque has almost entirely lost sight of any work done in the group during the past ten years in England. As an illustration Mr. Baker appends a list of the Mascarene Symphonias, among which are described two new species. Of the thirteen species enumerated M. Vesque had only made note of six.

AT A MEETING of the Linnean Society last December, as reported in *Gardener's Chronicle* (Dec. 15th), Sir Dietrich Brandis presented a revision of the *Dipterocarpeæ*, an order which consists almost entirely of large trees which do not flower until they have attained great size, with a spreading crown on a branchless stem often more than 100 feet high. For this reason adequate material for determinations has been very difficult to secure, and has only lately been at all full. In 1840 Korthals described 34 species; DeCandolle, in 1868, described 126; Thistleton Dyer, in 1874, estimated the number at 170. Sir D. Brandis now estimates that there are 320 species belonging to 16 genera.

PROFESSOR E. L. GREENE continues his "Observations on the Compositæ" in the current number of *Erythea* (Jan.). The maze of asteroid forms are further considered and new generic lines proposed. Maintaining *Solidago* as a genus, and restricting it on the basis of habit and inflorescence (never flat-topped), he outlines the Nuttallian genus *Chrysoma*, with fifteen species, which have been variously referred to Solidago, Aster, Aplopappus, Ericameria, Linosyris, Bigelovia, Diplopappus, and Gundlachia. *Stephanodoria*, *Petradoria*, and *Osbertia* are proposed as new genera; the first to contain *Xanthocephalum tomentellum* Robinson; the second, *Solidago pumila* T. & G.; the last of the various forms of the Mexican and Central American plants that have been referred to Aplopappus stoloniferus.



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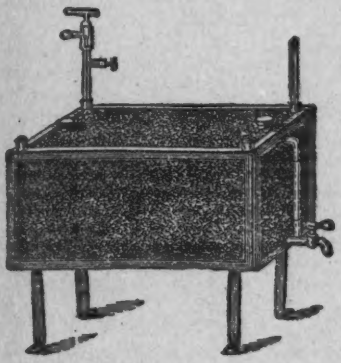

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